

Access the recorded webinar here:

<https://attendee.gotowebinar.com/recording/8381465392583456769>

Access speaker bios here:

<https://files.asprtracie.hhs.gov/documents/aspr-tracie-healthcare-challenges-after-chemical-incidents-webinar-speaker-bios.pdf>

Access Q & A here:

<https://files.asprtracie.hhs.gov/documents/aspr-tracie-chemical-incidents-webinar-qa-508.pdf>



**T R A C I E**

HEALTHCARE EMERGENCY PREPAREDNESS  
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# Healthcare Challenges in Chemical Incidents

January 14, 2020

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# ASPR TRACIE: Three Domains



- Self-service collection of audience-tailored materials
- Subject-specific, SME-reviewed “Topic Collections”
- Unpublished and SME peer-reviewed materials highlighting real-life tools and experiences



[asprtracie.hhs.gov](https://asprtracie.hhs.gov)



- Personalized support and responses to requests for information and technical assistance
- Accessible by toll-free number (1844-5-TRACIE), email ([askasprtracie@hhs.gov](mailto:askasprtracie@hhs.gov)), or web form ([ASPRtracie.hhs.gov](https://asprtracie.hhs.gov))



1-844-5-TRACIE



- Area for password-protected discussion among vetted users in near real-time
- Ability to support chats and the peer-to-peer exchange of user-developed templates, plans, and other materials



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**Duane Caneva, MD, MS**  
Chief Medical Officer  
U.S. Department of Homeland Security



# DHS at a Glance

- Approximately 240K personnel
- FY 2019 Budget Request: \$74B (direct appropriations, fees, disaster assistance)
- Core Missions of the Department:
  - Securing Our Borders
  - Enforcing Our Immigration Laws
  - Maritime Security
  - Critical Infrastructure Security and Resilience
  - Transportation Security
  - Disaster Preparedness and Resilience
  - Executive Protection/Financial Crimes



*Large Department with Broad Authorities and Mission*



Homeland  
Security

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Countering Weapons of Mass Destruction

# Chief Medical Officer Responsibilities



- *Serve as principal advisor* to DHS Secretary, the FEMA Administrator, the CWMD Assistant Secretary, and Department officials for medical and public health issues
- *Coordinate* with federal, state, local, tribal, and territorial governments, the medical community, and others outside the Department, such as CDC and HHS Assistant Secretary for Preparedness and Response (ASPR), *for medical and public health matters*
- Provide operational medical support to all components of the Department
- Provide medical expertise and support to front line operators/EMTs and for biodefense planning and preparedness



# High Priority Projects and Areas of Focus

- Southwest border surge and public health best practices for border towns
- Ebola preparedness and enhanced medical screening at select ports of entry
- Community readiness/ WMD programs
  - BioWatch
  - Securing the Cities
  - Chemical incident preparedness
  - Fusion centers
- First Responder Vaccine Initiative (FRVI) Pilot
- EMS and law enforcement engagement
- CReDO—Community Response to Drug Overdose



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**John Hick, MD**  
Hennepin Healthcare & ASPR Moderator



# Webinar Objectives/ Setting Stage

- Webinar Objectives:
  - Discuss the potential effects of a chemical incident
  - Share recent guidance and lessons learned in assessing, triaging, and treating patients, including considerations for novel nerve agent treatment
- ASPR TRACIE Exchange Issue 9: Preparing for and Responding to Chemical Incidents
- ASPR TRACIE Chemical Hazards Topic Collection





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**Susan Cibulsky, PhD**  
Senior Policy Analyst  
HHS ASPR



# HHS ASPR

- Public health and medical emergency support for a nation prepared
- Emergency management and medical operations
- Biomedical Advanced Research & Development Authority (BARDA)
- Strategic National Stockpile
- Information management, strategy, policy, planning, requirements

# Interagency Coordination

- Within HHS:

- NIH
- CDC
- FDA



- Outside HHS

- DoD
- DHS
- DoS
- USDA
- VA
- ODNI

# Introduction to Fourth Generation Agents (FGAs)

- What are FGAs?
- FGA characteristics
- Incident recognition
- PPE
- Patient decontamination

\*There is no known threat of Fourth Generation Agent use in the United States

# What Are Fourth Generation Agents?

- Fourth generation agents – aka Novichok, aka A-series agents
  - 1<sup>st</sup> generation chemical warfare agents: phosgene, chlorine, mustards
  - 2<sup>nd</sup> generation: G-series nerve agents (sarin, soman,...)
  - 3<sup>rd</sup> generation: V-series nerve agents (VX,...)
- Developed as weapon by Soviet Union to defeat Western countermeasures

# What Are Fourth Generation Agents?

- A230
- A232
- A234
- FGAs are organophosphorus nerve agents
- FGAs inhibit acetylcholinesterase, causing cholinergic crisis
- Highly toxic/potent: similar to VX
- Unique characteristics pose challenges to response operations

# FGA Characteristics

- Persistent in the environment
  - Low volatility – extremely low vapor pressure; 5-10x lower than VX
  - High water solubility
  - High chemical stability
- Likely to be encountered as liquid
- Absorbed through skin and mucus membranes
- Also toxic by inhalation or ingestion
- Limited data are available from research studies or real-world experiences

# FGA Incident Recognition

## Clinical Recognition

- Victim signs/symptoms may be first indication of FGA use
- FGAs cause cholinergic crisis, same toxidrome as other nerve agents
- Patients may demonstrate some combination of the following:
  - SLUDGE: Salivation, Lacrimation, Urination, Defecation, GI upset, Emesis
  - DUMBBELS: Defecation, Urination, Miosis/Muscle weakness, Bronchospasm/Bronchorrhea, Bradycardia, Emesis, Lacrimation, Salivation/Sweating
- Delay between skin exposure and symptom onset may be longer than for VX (several hours possibly up to 3 days)
- Victims may be far from point of exposure before symptoms occur



# FGA Incident Recognition

## Clinical Recognition – Salisbury, UK examples

- Initial presentations in Salisbury cases included only small # of symptoms of cholinergic crisis
  - Miosis, bradycardia, decreased level of consciousness
  - Other, common, exposures can cause these: alcohol, opioids, benzodiazepines
- Alerts about synthetic opioid overdose had just been issued
- Additional symptoms of cholinergic crisis developed over 1<sup>st</sup> 24 hours
  - Sweating in absence of fever, fluid loss, muscle fasciculations, profound bradycardia
- Delayed signs and symptoms highlight the importance of standard precautions at all times

# FGAs: Personal Protective Equipment

- FGAs are highly potent; contacting small amounts can cause serious toxicity
- Responders must take measures to prevent any contact with:
  - Liquid agent
  - Suspected contaminated surfaces
  - Potentially contaminated people
- Patients may arrive at hospital before incident recognized
- Agent confirmation will take time
- Practice standard precautions

# FGAs: Personal Protective Equipment

- PPE requirements are the same as for VX
- Follow your standard operating procedures for a nerve agent such as VX
- Adhere to appropriate PPE use, including strict discipline in doffing PPE procedures

# FGAs: Decontamination of Patients

- Patient decontamination is a medical countermeasure
- Decontamination of skin and hair is critical in cases of exposure to liquid
- Absorption of FGAs through skin takes time; there appears to be a depot effect in skin
  - Decontamination may provide clinical benefit even when performed hours to days after exposure to liquid agent, although the earlier the decontamination, the better
  - Repeated decontamination may be necessary

# FGAs: Decontamination of Patients

- Decontaminate with:
  - Soap and water
  - Reactive Skin Decontamination Lotion (RSDL) for spot decontamination
- FGAs are not readily degraded by water
  - Avoid direct contact with decontamination runoff
  - Contain runoff as soon as possible



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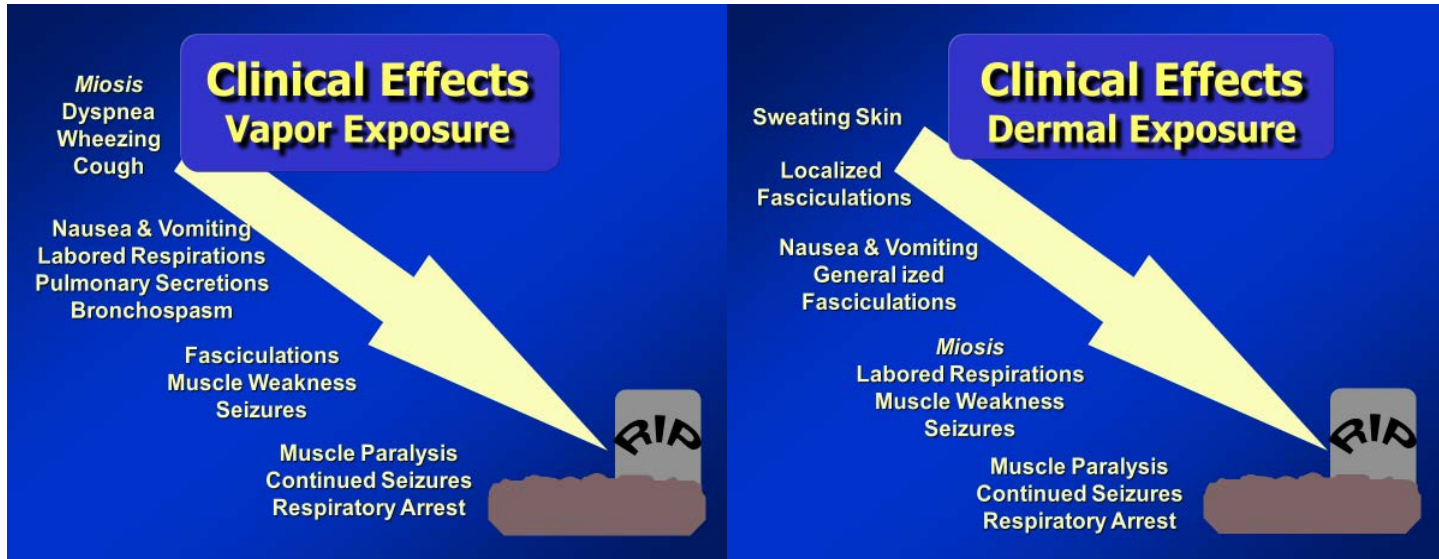
**Mark Kirk, MD**  
Director, Chemical Defense Program  
U.S. Department of Homeland Security



# Key Messages

- Achievable goals: protecting healthcare staff and a positive health outcome for victims of FGA exposure
- How: meticulous attention to what we already know
  - Standard precautions with ALL patients with AMS
  - Supportive/symptomatic care before focusing on specialized treatments
  - If suspicious of acetylcholinesterase (ACHE) inhibitor poisoning, titrate antidotes to clinical effects regardless of which agent
- Expect FGAs will create unique challenges
  - Uncertainty of diagnosis
  - Prolonged intensive care management and large, repeated doses of antidotal therapy may be necessary (potential scarce resource scenario)

# ACHE Inhibitors: OP insecticides and chemical warfare nerve agents cause variable clinical presentations





# Nerve Agent Poisoning Treatment

- Decontamination / Self Protection
- Supportive Care
  - *Patients Die a Respiratory Death*
- Antidotes
  - Anticholinergics (Atropine)
  - Oxime AChE reactivators
  - Anticonvulsants (Benzodiazapines)



# Clinical Course

EMS finds two individuals altered on a park bench

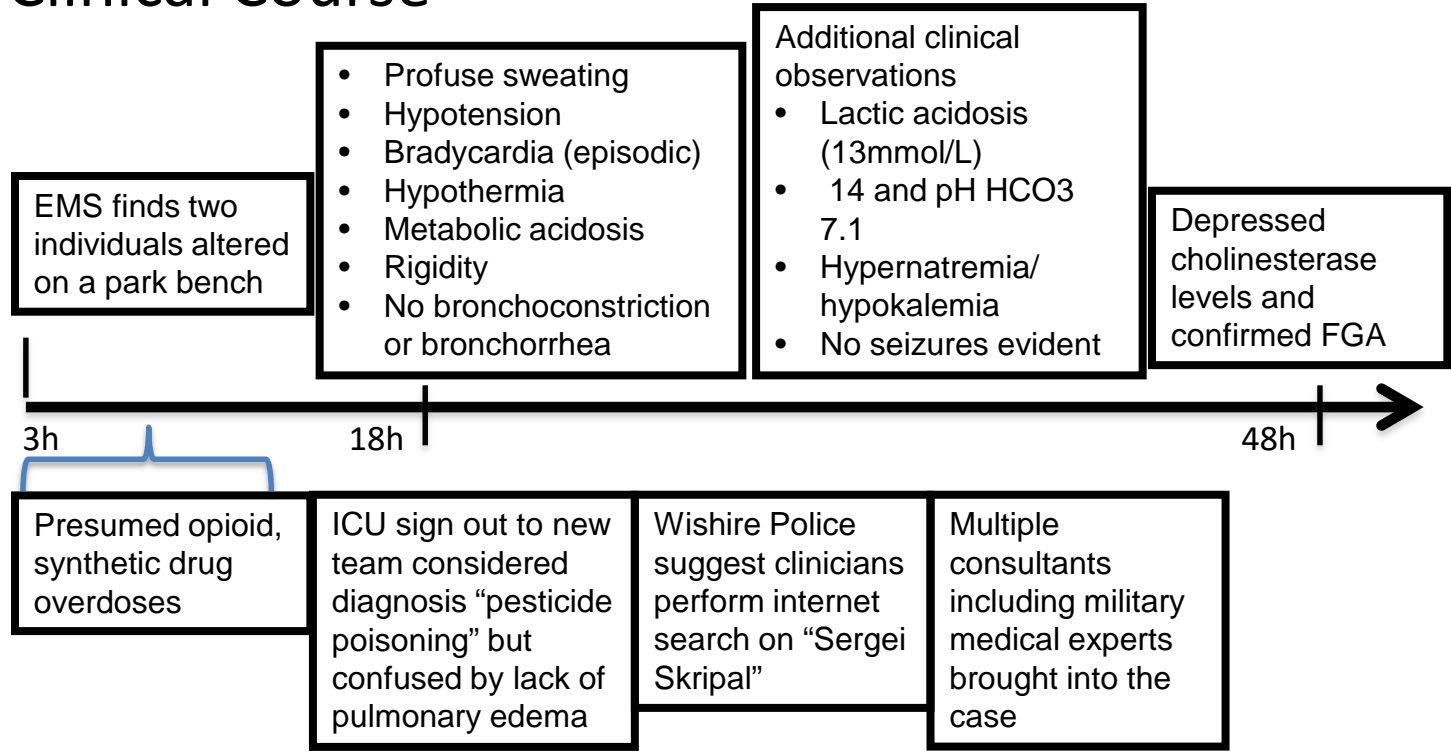
## Patient 1

- Eyes open & staring
- 158/94;88;14
- Pinpoint pupils
- Increase motor tone
- Oral secretions
- Lungs clear
- Vomited (after naloxone)

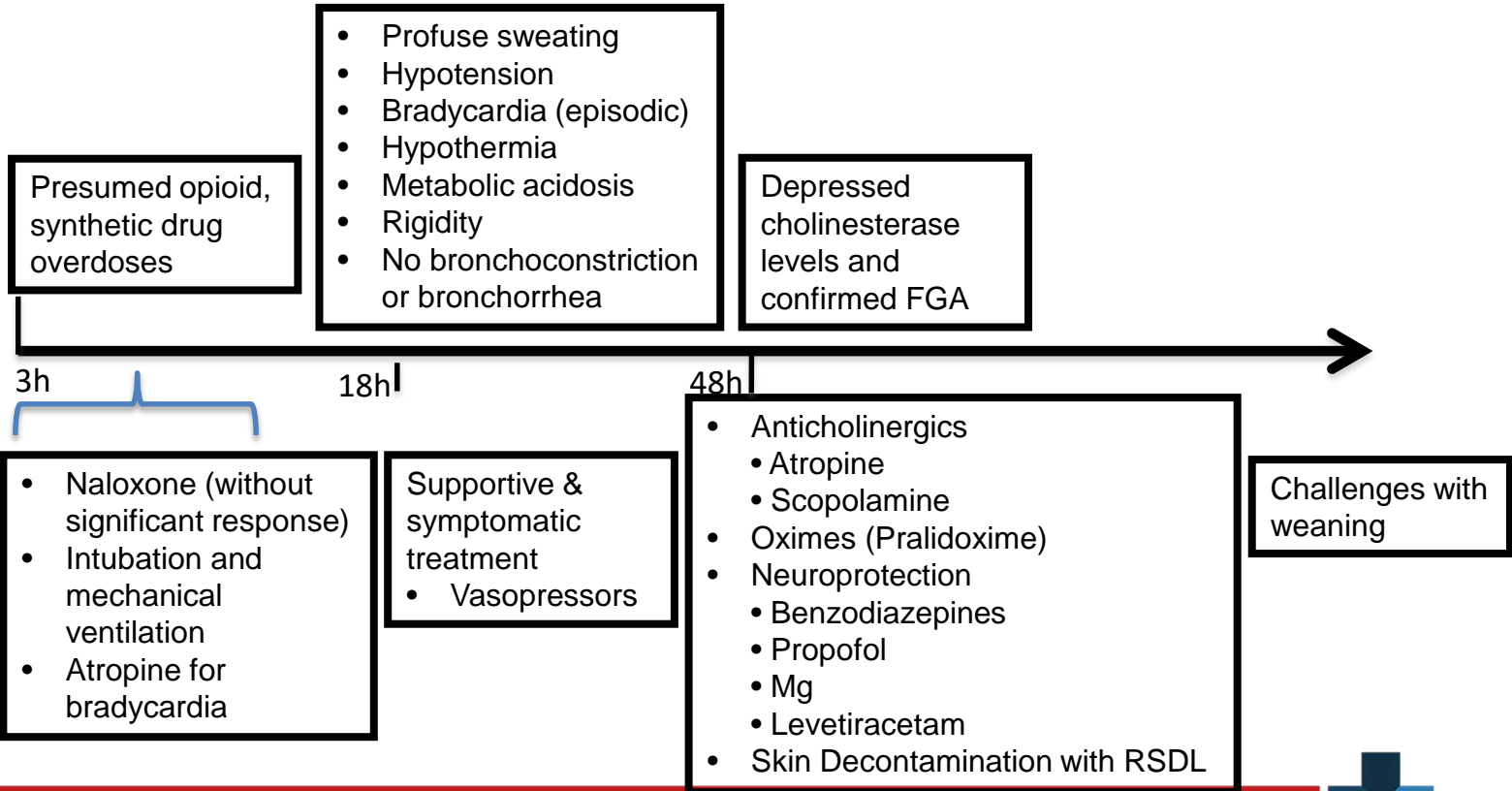
## Patient 2

- Unconscious
- 164/90;42;Apneic
- Pinpoint pupils
- Oral secretions
- Lungs clear
- Trismus/fasciculations around mouth
- Flaccid limbs

# Clinical Course



# Clinical Course Treatment



# FGA – Unique Clinical Pearls

- Latent period - many hours
  - Onset of symptoms may be delayed many hours
  - Slow progression of symptoms - obvious toxidrome evolves over many hours
- Expect clinical effects similar to other nerve agents
  - Expect requiring higher doses and prolonged use of repeated dosing
  - Lactic acidosis and hemodynamic instability
  - Seizures, bronchoconstriction, bronchorrhea not observed in patients

# Other Considerations

- Additional Casualties
  - Police officer exposed during investigation
  - 2 people exposed from discovering perfume spray bottle in trash (1 death)
- Expert Consultation
- Risk Communication



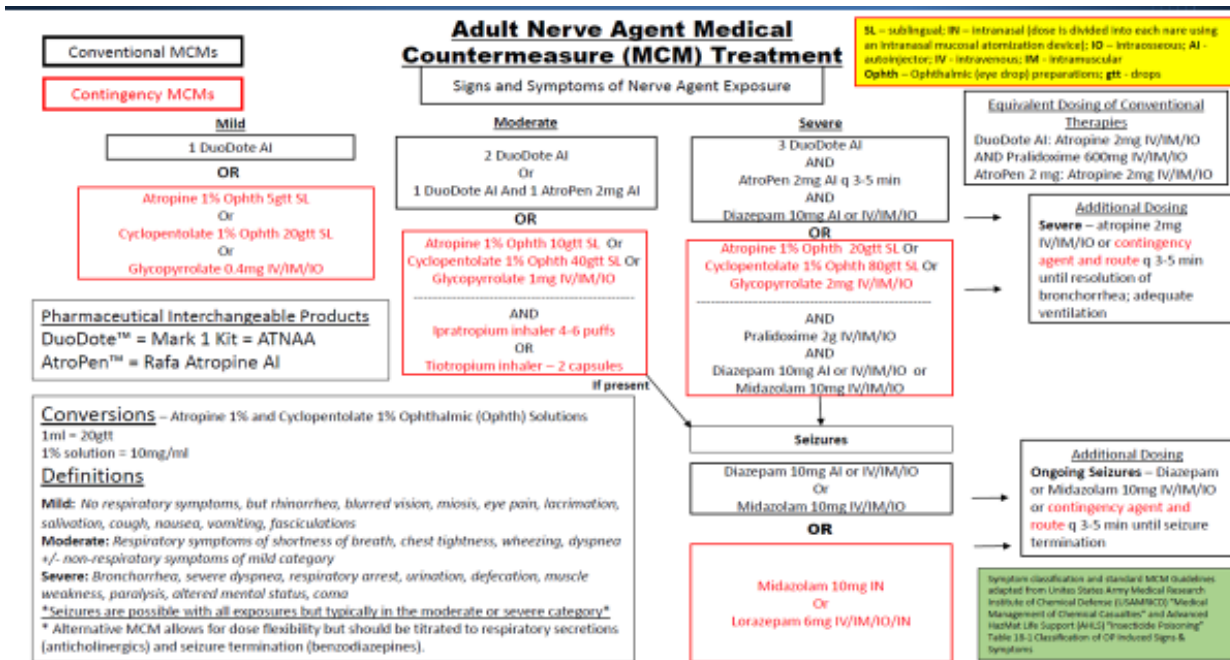
# Potential Drug Shortage Situation

## Challenges

- Forecasting needs
  - What and how much do we have?
  - What do we need?
- Finding alternatives on the fly
- What else might be effective instead of the recommended treatment?
- Administration
  - Adapting protocols
  - Just in time training



# Contingency Medical Countermeasures for Treating Nerve Agent Poisoning



**Seizures**

Diazepam 10mg AI or IV/IM/IO  
Or  
Midazolam 10mg IV/IM/IO

OR

Midazolam 10mg IN  
Or  
Lorazepam 6mg IV/IM/IO/IN

**Conversions** – Atropine 1% and Cyclopentolate 1% Ophthalmic (Ophth) Solutions  
1ml = 20gtt  
1% solution = 10mg/ml

**Definitions**  
**Mild:** No respiratory symptoms, but rhinorrhea, blurred vision, miosis, eye pain, lacrimation, salivation, cough, nausea, vomiting, fasciculations  
**Moderate:** Respiratory symptoms of shortness of breath, chest tightness, wheezing, dyspnea +/- non-respiratory symptoms of mild category  
**Severe:** Bronchorexia, severe dyspnea, respiratory arrest, urination, defecation, muscle weakness, paralysis, altered mental status, coma  
*\*Seizures are possible with all exposures but typically in the moderate or severe category.\**  
*\* Alternative MCM allows for dose flexibility but should be titrated to respiratory secretions (anticholinergics) and seizure termination (benzodiazepines).*

**Legend:**  
SL – sublingual; IM – intramuscular [dose is divided into each mare using an intramuscular atomization device]; IO – intranasal; AI – autoinjector; IV – intravenous; IN – intranasal  
Ophth – Ophthalmic (eye drop) preparations; gtt – drops

[https://chemm.nlm.nih.gov/Contingency-NA-MCM-Guidance\\_rev-20-Dec-2018.pdf](https://chemm.nlm.nih.gov/Contingency-NA-MCM-Guidance_rev-20-Dec-2018.pdf)





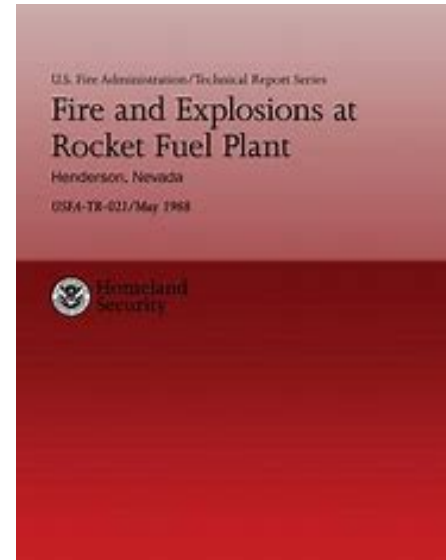
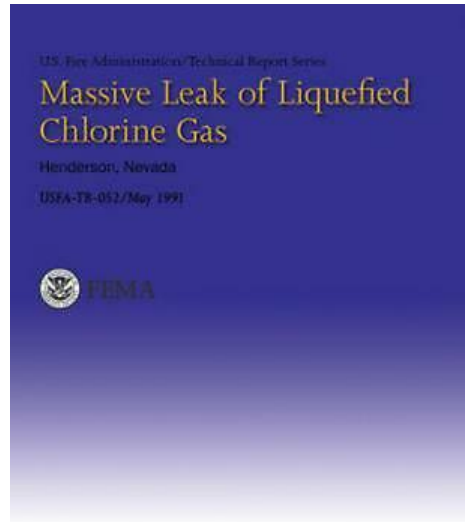
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**Bruce Evans, MPA, NRP, SPO, CFO**  
Upper Pine River Fire (CO)



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# Experience from the Field



# Experience Lessons

- Listen to plant experts
- Understand chemistry
- Question deviations of protocol or hazardous material operating site practices
- Gather everything for after action reports



# Train, Train, Train

- Get in the suits and use the meters
- Conduct research on the fly
- Use tracer materials to verify decontamination
- Get toxicology education
- Learn who to trust in the command structure
- Abide by crew resource management principles; speak up respectfully
- Take advantage of federally supported training



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**Stephen Grant, MD**  
Lexington Medical Center (SC)



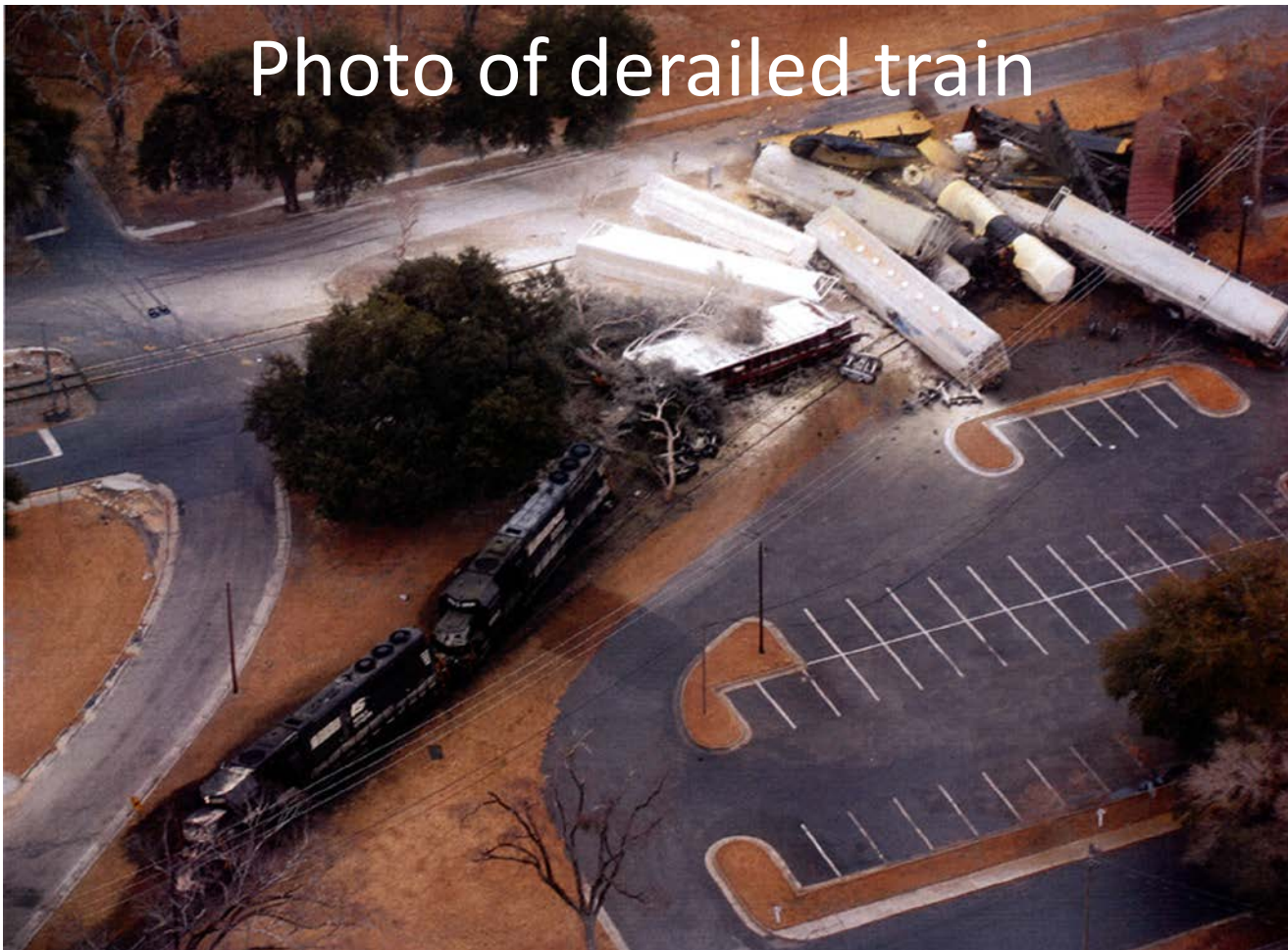
# Graniteville Chlorine Disaster: Jan 6, 2005

- Norfolk Southern Train 192
- 42 Car, 3 Engine, 2 Crew Members
- Went off main line onto siding @ 47 MPH
  - Crashed into 3 car, 1 Engine Train P22
  - Parked for night - Mandatory rest
- Manual switch not reset to main line

# 16 of 42 Cars Derailed at 2:42 am

- Automatic brake was deployed
- After collision, main line train bounced backwards
  - No traumatic injuries noted to crew
- Derailment occurred at switch
- All 3 chlorine tankers derailed
  - One chlorine tanker ruptured

# Photo of derailed train





# Estimated Extent of Chlorine Cloud

- 2500 feet to North
- 1000 feet to East, West and South
- Release of gas caused cooling of tanker
  - Liquefied remaining Cl<sub>2</sub>
  - Limited further release
- Estimated 46 of 90 tons released
- RR and plant located along canal in valley

# Rapid Evacuation

- 500 workers at Woodhull Plant
- Managers/workers huddled at back of plant
- Workers had to shut down boilers
- Noxiousness: rapid evacuation decision
  - **Came by POV to hospital**
- Five of these employees among dead

# Aiken Regional at Time of Disaster

- 14 bed Emergency Department (5 E.C.)
- ICU beds available: 1
- Major remodeling of ED underway
- Staff
  - 1 ED Physician
  - 5 Nurses, 2 Techs, 2 RTs in hospital
  - 1 X-ray tech

## 3 AM: Mass Confusion in ED

- EMS dispatch 2:54 alerted ED of wreck
- Dozens of patients arrived in minutes
- Strong “Swimming Pool” smell on patients
- Trauma Alert called
- Triage Nurse overwhelmed

# Triaging Initial Wave

- Oxygen and Pulse Ox's brought to triage
- Universal complaints were
  - Burning eyes and throat
  - Chest discomfort
  - SOB
- Low pO<sub>2</sub> = ED Admit

# Public Safety Decisions

- Police arrived at hospital: crowd control
- Deputy asked “What can I do”
- Dr. Yeh: Take non-critical patients away
  - Transported to campus across street
  - Decontaminated and re-triaged
  - Many sent to other area hospitals

# Public Safety at Scene

- Area quarantined by about 3 AM
- Command Center established 3 AM
  - Subsequently pulled back from site
- Call for all EMS units/ bring PPE
- Decontamination center across street
- Setup by 3:35 AM across from hospital
- Two additional decontamination centers

# Distribution of Patients : Area Hospitals

	Treated	Admits	ICU	Died
<b>ARMC</b>	112	24	4	1
<b>UH</b>	123/93	20	4	0
<b>MCG</b>	32	14	1	0
<b>St. Joe's</b>	9	3	0	0
<b>Doctor's</b>	30	12	3	0
<b>Lexington</b>	5	5	1	0



# Secondary Assessment of Patients

- H & P
- Portable CXR - Hard copy stayed with patient
- ABG: first 4-5 ruled out Meth-HGB
- Monitors especially Pulse Ox
- Registration overwhelmed: Paper Charts
  - Many patients seen, not registered

# Chlorine Gas

- Wide industrial use
  - H<sub>2</sub>O Purification, Bleaching Paper, PVC
- Transported by rail, truck
- Much heavier than air or water
- Yellow-greenish gas
  - Permissible level 1 PPM (OSHA)
  - Detectable 0.2 -3.5 PPM
  - Rapidly fatal 1000 ppm

# Chlorine: Acute Toxicity

- Burning eyes, nose, throat, and cough
- CP, SOB, wheezing
- Pulmonary Edema:
  - Active Arterial and Capillary Hyperemia
  - Plasma Exudate fills Aveoli



# Treatment of Cl<sub>2</sub>

- Decontamination
- Oxygen
- Bronchodilators
- Mechanical Ventilation
- Inhaled BiCarb

# Surge Capacity: Hospital

- Cancel all day and elective surgery
- Freed up massive resources
  - Day surgery intake/recovery 20 beds
  - Recovery room became 2<sup>nd</sup> ICU Area
- Large day staff due in by 6:30 AM
  - Day surgery – Treatment for non-acute
  - Express care – Secondary triage

# Top Ten Take Home Points

- 10- Every mass disaster is unique
- 9- Have a talented ED rep at the EOC
- 8- Quickly establish perimeters/security at scene and at ED and hospital
- 7- Decontamination area away from triage
- 6- Hospital must *Clear the Decks*

# Top Ten Take Home Points

- 5- Main ED: staff it with ED personnel
- 4- Quickly expand treatment areas
- 3- Stick to your knitting
- 2- Charts: paper is quickly transferable
- 1- Design your disaster response to fail intelligently:
  - Paper charts
  - Backup power





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**Moderator Roundtable**  
John Hick, MD



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# Question & Answer



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